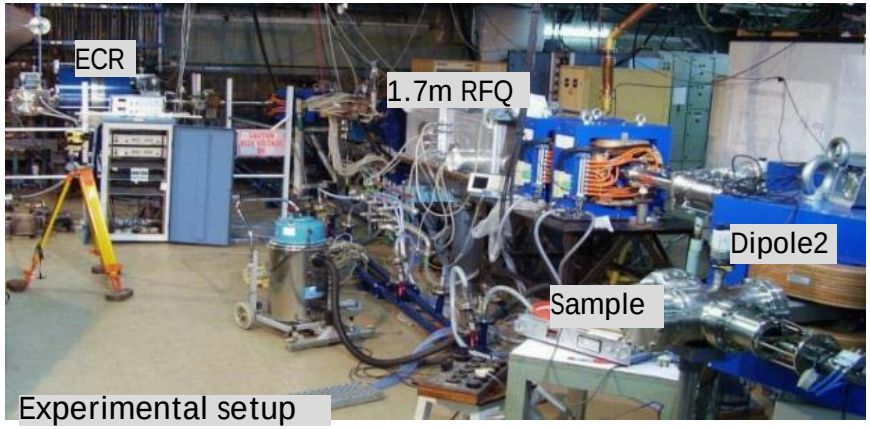
Study on room temp. ferromagnetism in ZnO; effect of Fe Ion-implantation

Nucl. Instrum. & Meth. B267 (2009) 1783 ; Phys. Lett. A371 (2007) 482

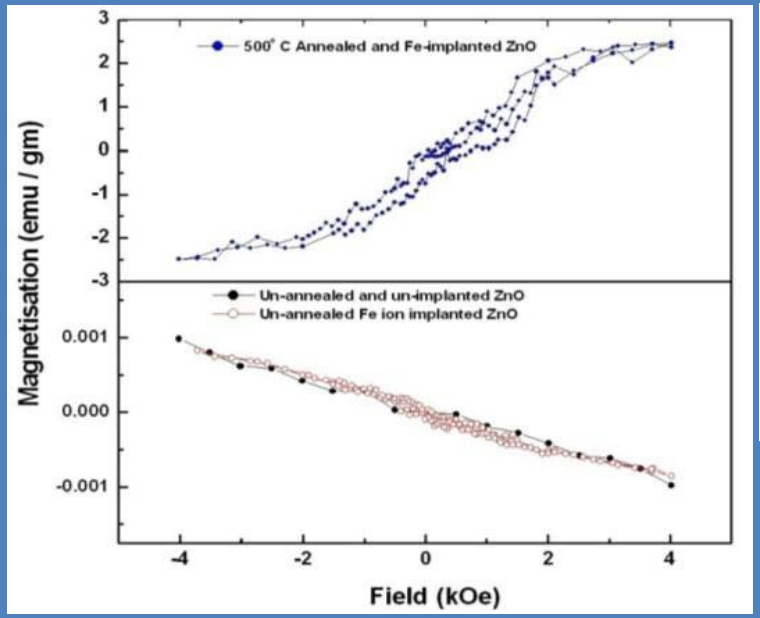
Ion implantation of Fe beam accelerated in RFQ

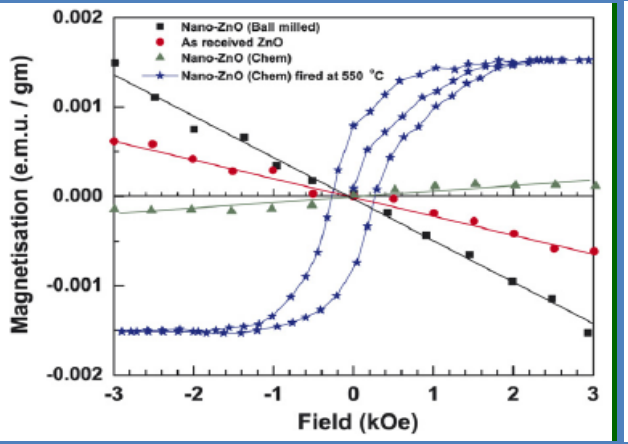


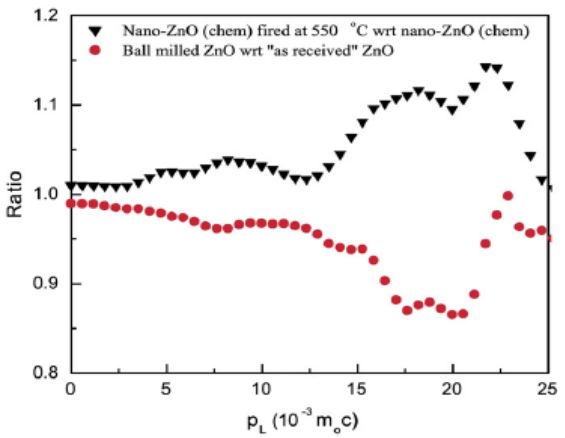
Experimental setup

Spintronics : ZnO - potential candidate ; prediction that it may show ferromagnetic ordering at room temperature

- Positron annihilation studies at VECC show clearly that defects govern room temperature ferromagnetic properties of nano-crystalline ZnO. For this study $^{56}Fe^{6+}$ ions with energy 1.63 MeV & dose of 10^{16} of were implanted in 0.75 micron ZnO sample.
- Enhanced positron annihilation with core electrons of Zn observed in 500 °C annealed ZnO ; strong correlation between defects and ferromagnetism seen experimentally
- Two orders enhancement in saturation magnetic moment seen in Fe ion-implanted ZnO (500 °C annealed).







(left) Enhanced saturation magnetic moment in 500 °C annealed Iron implanted ZnO, compared with un-implanted annealed ZnO (top)

Ratio of electron-positron momentum distribution for various samples. Enhancement in higher momentum region indicates preferred annihi-lation with Zinc 3d core electrons

1.63 MeV Iron beam accelerated in RFQ beam implanted in ZnO

ELSEVIER

Nuclear Instruments and Methods in Physics Research B

journal homepage: www.elsevier.com/locate/nimb

BEAM INTERACTIONS WITH MATERIALS AND ATOMS

Observation of high ferromagnetic ordering in Fe implanted ZnO at room temperature

D. Sanyal *, Mahuya Chakrabarti, Vaishali Naik, Tapatee Kundu Roy, Debasis Bhowmick, Siddhartha Dechoudhury, Arup Bandyopadhyay, Alok Chakrabarti

Variable Energy Cyclotron Centre, 1/AF, Bidhannagar, Kolkata, West Bengal 700064, India

4 MeV Argon beam accelerated in RFQ implanted in TiO_2

Journal of Physics D: Applied Physics > Volume 47 > Number 2

Room temperature ferromagnetic ordering in 4 MeV Ar^{5+} irradiated TiO_2

D Sanyal[1,4], Mahuya Chakrabarti[2], P Nath[2], A Sarkar[3], D Bhowmick[1] and A Chakrabarti[1]

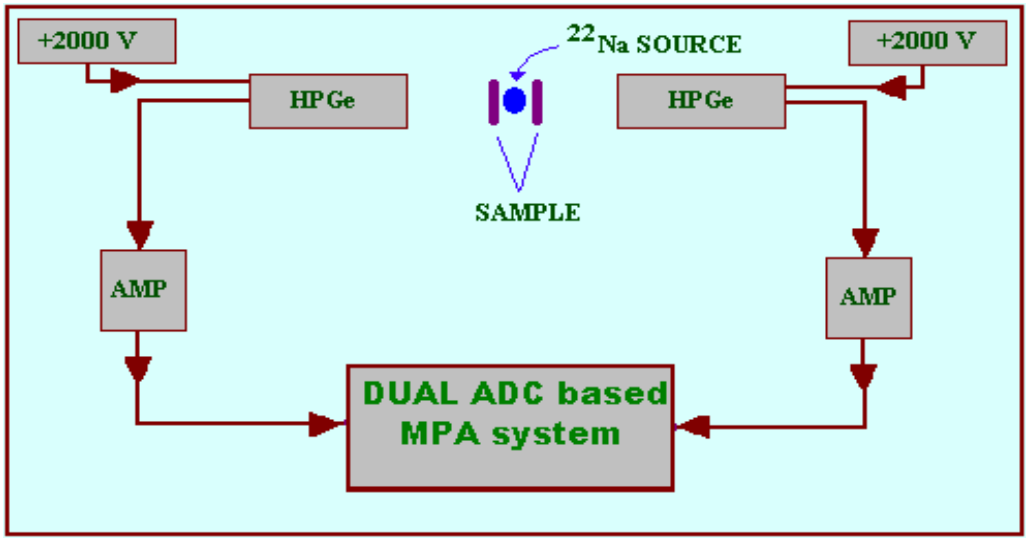
Hide affiliations

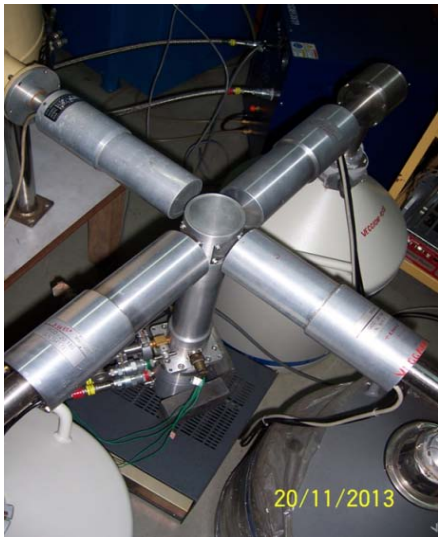
dirtha@vecc.gov.in

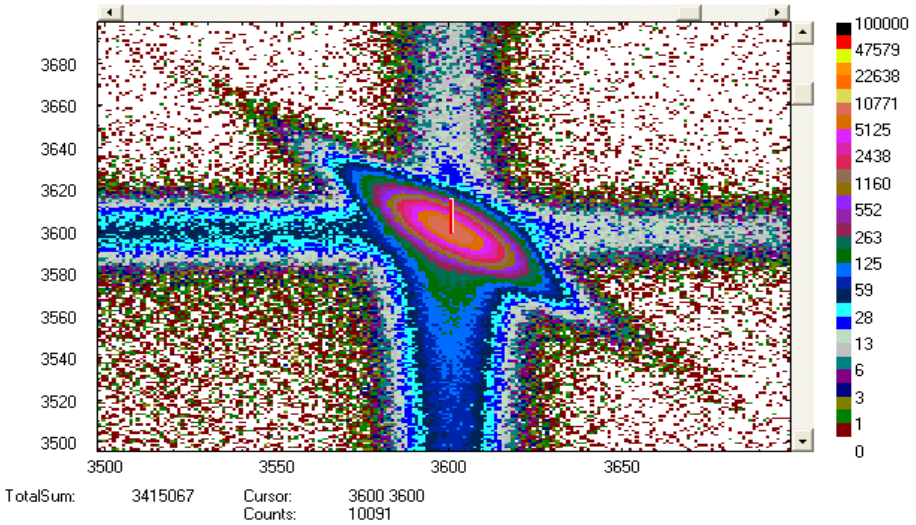
[1] Variable Energy Cyclotron Centre, 1/AF, Bidhannagar, Kolkata 700064, India
[2] Department of Physics, University of Calcutta, 92 Acharya Prafulla Chandra Road, Kolkata 700009, India
[3] Department of Physics, Bangabasi Morning College, 19 Rajkumar Chakraborty Sarani, Kolkata 700009, India
[4] Author to whom any correspondence should be addressed.

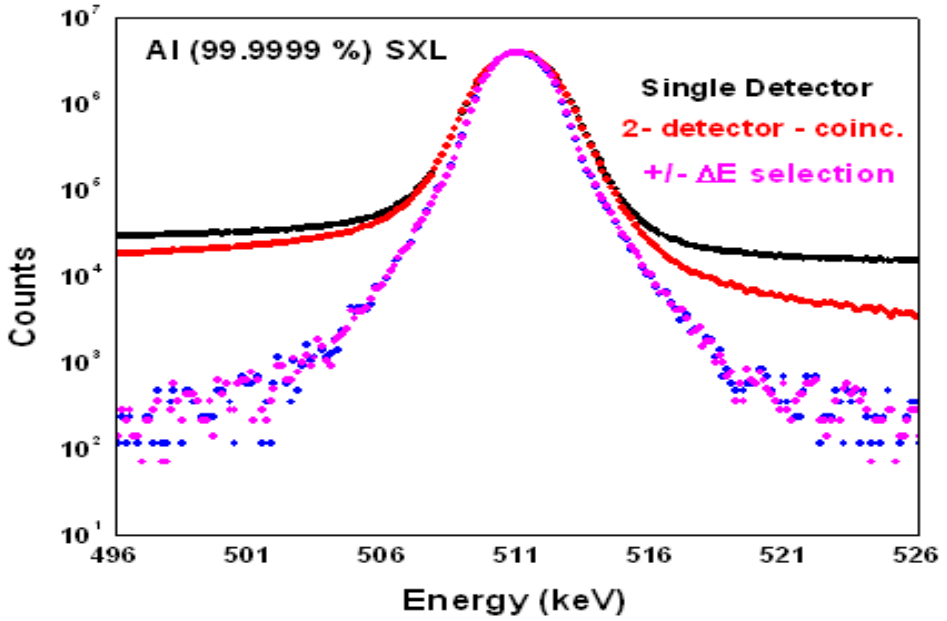
D Sanyal *et al* 2014 *J. Phys. D: Appl. Phys.* **47** 025001. doi:10.1088/0022-3727/47/2/025001
Received 31 August 2013, revised 20 October 2013, accepted for publication 8 November 2013. Published 11 December 2013.

A typical Doppler broadening spectrometer









JACS
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

Article

(2014) 136, 12712−12720

pubs.acs.org/JACS

Temperature Dependent Reversible *p*−*n*−*p* Type Conduction Switching with Colossal Change in Thermopower of Semiconducting AgCuS

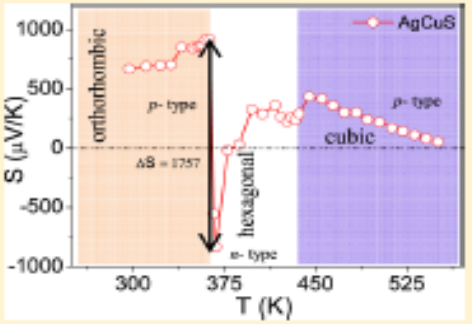
Satya N. Guin,[†] Jaysree Pan,[§] Arghya Bhowmik,[§] Dirtha Sanyal,[‡] Umesh V. Waghmare,[§] and Kanishka Biswas*[,†]

[†]New Chemistry Unit and [§]Theoretical Sciences Unit, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Jakkur P.O., Bangalore 560064, India

[‡]Variable Energy Cyclotron Centre, 1/AF Bidhannagar, Kolkata 700064, India

Supporting Information

ABSTRACT: Semiconductors have been fundamental to various devices that are typically operated with electric field, such as transistors, memories, sensors, and resistive switches. There is growing interest in the development of novel inorganic materials for use in transistors and semiconductor switches, which can be operated with a temperature gradient. Here, we show that a crystalline semiconducting noble metal sulfide, AgCuS, exhibits a sharp temperature dependent reversible *p*−*n*−*p* type conduction switching, along with a colossal change in the thermopower (ΔS of ~1757 μV K^{-1}) at the superionic phase transition (T of ~364 K). In addition, its thermal conductivity is ultralow in 300−550 K range giving AgCuS the ability to maintain temperature gradients. We have developed fundamental understanding of the phase transition and *p*−*n*−*p* type conduction switching in AgCuS through temperature dependent synchrotron powder X-ray diffraction, heat capacity, Raman spectroscopy, and positron annihilation spectroscopy measurements. Using first-principles calculations, we show that this rare combination of properties originates from an effective decoupling of electrical conduction and phonon transport associated with electronic states of the rigid sulfur sublattice and soft vibrations of the disordered cation sublattices, respectively. Temperature dependent *p*−*n*−*p* type conduction switching makes AgCuS an ideal material for diode or transistor devices that operate reversibly on temperature or voltage changes near room temperature.



AgCuS could be a promising material for the thermally activated transistor

http://www.natureasia.com/en/nindia/article/10.1038/nindia.2014.129

Chemical Science

EDGE ARTICLE

View Article Online
View Journal

Cite this: DOI: 10.1039/c5sc02966j

The effect of order–disorder phase transitions and band gap evolution on the thermoelectric properties of AgCuS nanocrystals†

Satya N. Guin,[a] Dirtha Sanyal[b] and Kanishka Biswas*[a]

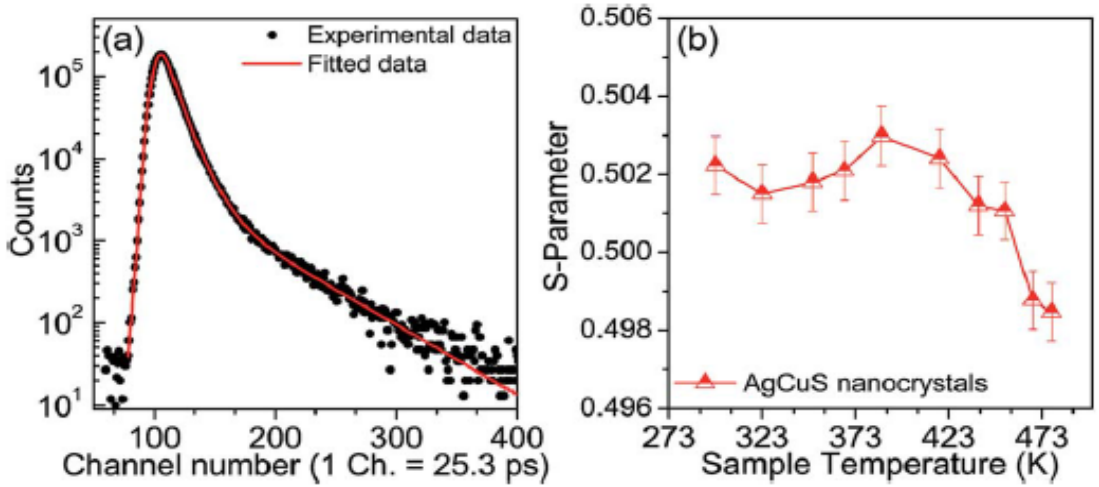


Fig. 9 (a) Room temperature positron annihilation lifetime spectrum for the AgCuS nanocrystals (obtained after 30 min of reaction). Solid red line shows the fitting for the determination of positron life time components (b) Temperature dependent Doppler broadening S-parameter of nanocrystalline AgCuS (30 min of reaction).

THE JOURNAL OF PHYSICAL CHEMISTRY Letters

DOI: 10.1021/acs.jpclett.7b00446
J. Phys. Chem. Lett. 2017, 8, 1745−1751

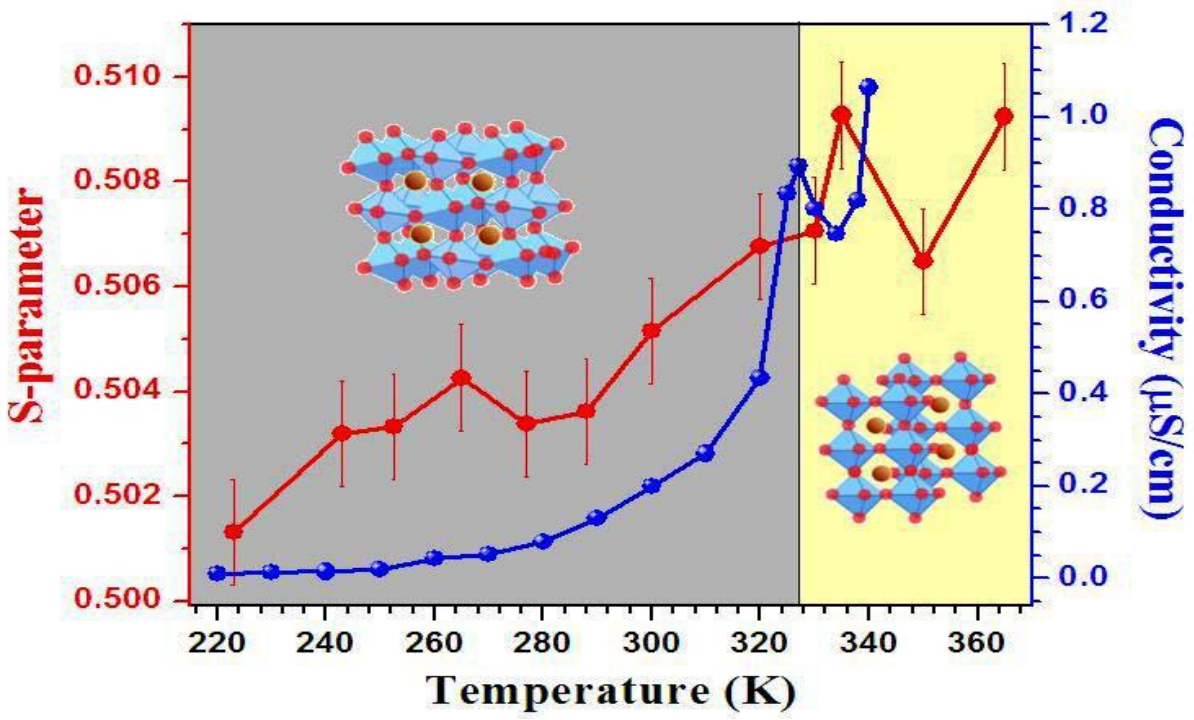
Letter

pubs.acs.org/JPCL

Positron Annihilation Spectroscopic Investigation on the Origin of Temperature-Dependent Electrical Response in Methylammonium Lead Iodide Perovskite

Joydeep Dhar,[†] Sayantan Sil,[†] Arka Dey,[†] Partha Pratim Ray,*[,†] and Dirtha Sanyal*[,‡]

[†]Department of Physics, Jadavpur University, Kolkata 700032, India
[‡]Variable Energy Cyclotron Centre, 1/AF, Bidhannagar, Kolkata 700064, India



Methylammonium lead halide ($MAPbI_3$) based perovskite materials have demonstrated more than 20 % power conversion efficiency as a photovoltaic (PV) material. We have investigated the origin of ionic conductivity in $MAPbI_3$ by positron annihilation spectroscopy